REMARKS

Claims 2-31 are pending in the application. Claims 2-31 are rejected. No amendment to those claims is submitted with this Reply.

Reply to the Rejection of Claims 2-31 under 35 U.S.C. § 103(a)

The Examiner has rejected Claims 2-29 (*sic*, 2-31) as being unpatentable over International Publication No. WO 97/46591 to Neale *et al.* ("Neale") in view of U.S. Patent No. 3,884,909 to Kightlinger *et al.* ("Kightlinger"). Specifically, the Examiner states –

> Neale et al relates to a granular crosslinked cationic starch added as swollen granules at the wet end of papermaking, i.e., furnish to improve strength of the paper. The swollen crosslinked cationic starch has a viscosity of less than 400 and preferably less than 50 cps, page 2. The crosslinking agent in Neale et al (page 3) is the same as the inhibiting agent of the present invention. The cross linking agent is used in an amount of at least 0.05% by weight of the starch. Degraded starch can be used, page 4 where, acid, alkali or enzyme treated starch are disclosed as suitable base starch for modification.
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> Kightlinger et al discloses a depolymerized or degraded crosslinked cationic starch in granular form. The modified starch is added in the wet end of paper making, i.e., internal addition. The modified starch has superior retention, in addition to other properties of cationic starch such as strength. Thus, it would have been obvious to optimize the degree of degradation of the starch would achieve the optimum retention and strength. Inherently, the claimed viscosity would be inherently be present. . . .
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> . . . . Applicants' arguments have been considered but are deemed unpersuasive of patentability. The arguments are premised on the difference in the nature of the crosslinking between the Neale et al and Kightlinger et al. The rejection is not based on the crosslinking process in Kightlinger et al but rather on the selection of degraded starch as the form of starch to be used in Neale et al. It is again noted that Neale et al discloses degraded starch as one of the starches that can be used. Kightlinger et al was merely cited to reinforce the selection of degraded starch as the starch to be used in Neale et al.

For the following reasons, Applicants respectfully traverse the Examiner's rejection of claims 2-31 as being unpatentable over Neale in view of Kightlinger.

Neale was discussed in Applicants' Reply of 4 February 2003, those arguments being incorporated herein. As previously shown, Neale teaches crosslinked cationic starches useful in

papermaking. The modified starch is prepared by swelling a cationized crosslinked starch under conditions selected so that the viscosity of the swollen product is less than 400 cps (Abstract).

The starch is modified by crosslinking the starch with an agent in an amount of 0.05% or more by weight of starch, with 0.05% to 1.0% being most preferred (p. 3, line 31 – p. 4, line1). In the Examples and 'Best Mode' provided by Neale, native starch is reacted with 0.1% by weight of crosslinker (p. 5, lines 13-15; Examples A-C; and Experimental Trials A and B). One skilled in the art would recognize this to be an extremely high level of crosslinking. According to Neale, this high level of crosslinking agent is required in order to prevent over-swelling or rupturing of the starch granules during cooking, thereby obtaining modified starches with gel point ranges that are much higher (95-100°C) than the unmodified starch (55-65°C) (p. 3, lines 21-23; Table 1). As such, the modified starch does not gel at the wet end of the papermaking process. The starch is cationized either subsequent to the crosslinking step or concurrent with the crosslinking step, with subsequent cationization being preferred (p. 4, lines 10-12; p. 3, lines 3-5).

As shown above, Neale teaches a gel point temperature range of the modified starch that is higher than that of the unmodified starch (*see*, p. 6, Table 1). Neale requires high or strong crosslinking in order to keep the granules intact until they are heated over dryers (p. 5, lines 23-25; p. 6, lines 29-33). Neale further teaches swelling the modified granules by heating them, *e.g.*, in a jet cooker at 70°C (*see*, p. 5, 'Best Mode of Carrying Out Invention', lines 19-20), and then adding these swollen, pregelatinized granules to the paper pulp at the wet end stage (p. 5, lines 20-25).

Kightlinger is cited by the Examiner the simply for selection of degraded starch as the starch to be used in Neale. The modified starch of Kightlinger is produced by (step 1) reacting a starch with an alkali-catalyzable crosslinking agent and the reaction product of the crosslinking agent with ammonia or with an amine, and then (step 2) depolymerizing (degrading) the resulting cationic crosslinked product (Abstract; col. 2, lines 5-9). Without the subsequent depolymerization/degradation step, the residual crosslinker in the first step will cause unwanted high crosslinking to occur (*see*, col. 6, lines 26-33, *esp*. lines 29-31 – ". . . depending upon the degree of crosslinking, might even be substantially incapable of gelatinization.").

As shown above, Neale is directed towards modified cationic starches that are strongly or highly crosslinked in order to keep the granules intact (*i.e.*, no gelatinization) during the wet-end stage in papermaking, and only gelatinize when drying the paper, thereby improving paper strength. Although Neale generally claims that any premodified starch can be used (p. 4, lines 4-6), one skilled in the art would recognize that degrading a starch prior to crosslinking will not provide a modified starch having a gel temperature higher than the unmodified base. (Kightlinger degrades after modifying the starch.) This is supported by the Tsai Declaration submitted herewith and the experimental data provided therein. The data found in that Declaration clearly shows that both a nondegraded modified starch (Starch 3, as exemplified in Neale with the exception being the amount of crosslinker) and a degraded starch (Starch 2 as presently claimed), when inhibited in the amount claimed, do NOT have a gel point temperature range greater than the unmodified starch (Starch 1). This is in contrast to Table 1 of Neale, wherein it is shown that the gel point temperature range of the modified starch is much higher than that of the unmodified starch. This can only be done by highly crosslinking the starch. The high gel temperature of the modified starch of Neale allows that starch to be added to the wet-end stage without gelling. This modified starch gels only when it is subjected to the higher temperatures of the dryers.

As such, one skilled in the art would not be lead to believe that a starch that has been highly degraded and then inhibited within a limit lower than that taught by Neale (for the present invention, about 0.001% to about 0.05% by weight of dry starch), thereby producing granules that can rupture and gel at a temperature lower than the temperature of the base starch, would result in a product with improved paper strength. Further, because the gel temperature of the degraded modified starch of the present invention is lower than the base starch, it is apparent that the starch of the present invention is not taught by Neale as the modified starch of Neale has a gel temperature well above the base starch. Finally, by a unique combination of degradation and crosslinking within a specified range, a modified starch according to the present invention that provides improved paper strength can be produced without particle size limitations. This modified starch can be added to the papermaking process either dry or preheated at low temperature at substantially lower amounts than the modified starch of Neale.

Accordingly, even if one skilled in the art were motivated to combine Neale with Kightlinger, one still would not have the degraded, inhibited, cationic starches of the presently claimed invention. Further, neither Neale nor Kightlinger, alone or in combination, teach or suggest the presently claimed invention of a degraded starch that is inhibited with a crosslinker in an amount of 0.001% to 0.05% by weight of dry starch.

It is believed that these remarks overcome the Examiner's rejection of claims 2-31 as amended as being unpatentable over Neale in view of Kightlinger under 35 U.S.C. § 103(a). Withdrawal of the rejection is respectfully requested.

It is believed that the above amendments and remarks overcome the Examiner's rejection of the claims under 35 U.S.C. § 103(a) as indicated herein above. Withdrawal of the rejection is therefore respectfully requested. Allowance of the claims is believed to be in order, and such allowance is respectfully requested.

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